Original Article

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Implementation and Assessment of a Proning Protocol for Nonintubated Patients With COVID-19

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ABSTRACT

Introduction: The COVID-19 pandemic has caused over 1,250,000 deaths worldwide. With limited therapeutic options, proning nonintubated patients emerged as a safe and affordable intervention to manage hypoxemia.

Methods: A proning protocol to identify and prone eligible patients was implemented. Patients were encouraged to self-prone for 2–3 hours, 3 times daily. Investigators created educational materials for nurses and patients and developed a COVID-19–specific proning order within the electronic health record (EHR). Investigators completed an 800-person retrospective chart review to study the implementation of this protocol.

Results: From March 22, 2020, to June 5, 2020, 586 patients were admitted to the COVID-19 floor. Of these patients, 42.8% were eligible for proning. Common contraindications were lack of hypoxia, altered mental status, and fall risk. The proning protocol led to a significant improvement in provider awareness of patients appropriate for proning, increasing from 12% to 83%, as measured by placement of a proning order into the EHR. There was a significant improvement in all appropriate patients documented as proned, increasing from 18% to 45% of eligible patients.

Conclusions: The creation of an effective hospital-wide proning protocol to address the exigencies of the COVID-19 pandemic is possible and may be accomplished in a short period of time.

Keywords: inpatient, self-proning, COVID-19

Introduction

The prone position was first recognized as a useful maneuver to improve oxygenation by Bryan in 1974.[1] Subsequent studies showed that proning improved oxygenation through a number of mechanisms: ventilation–perfusion matching by more homogenous ventilation,[2–4] draining secretions,[5] decreasing atelectasis,[6,7] and changing the position of the heart.[2,8] Early proning trials demonstrated improved oxygenation in intubated patients with acute respiratory distress syndrome (ARDS),[9] trauma,[10] pulmonary edema, and pulmonary fibrosis.[11] Initial randomized trials with intubated patients showed no benefit for survival,[12–16] but subsequent larger studies[17] and multiple meta-analyses[7,18–20] demonstrated that proning improves mortality in severe ARDS and is now standard of care for intubated patients.

Two studies before the pandemic explored the benefit of proning nonintubated patients. A small trial with 15 patients demonstrated that proning was safe and resulted in improved PaO_2/FiO_2 ratios.[21] Another observational cohort study investigating the use of prone positioning in conjunction with high-flow nasal cannula or noninvasive positive pressure ventilation also reported proning improved oxygenation.[22] The authors hypothesized that proning may prevent intubation in patients with moderate ARDS.

Recent trials have examined proning nonintubated patients with COVID-19 with mixed results.[23–25] A cross-sectional survey from Milan reported that 15 patients treated with noninvasive ventilation and proning showed significant improvement in the respiratory rate and oxygenation.[26] A prospective, single-center trial in France investigated the effect of prone positioning on 24 hypoxic, nonintubated patients and found that oxygenation improved in only 25% of patients.[27] A subsequent single-center cohort study from New York found a significant improvement in oxygenation in 29 nonintubated, hypoxemic patients with COVID-19.[28]

Journal for Healthcare Quality, Vol. 43, No. 4, pp. 195–203

The authors declare no conflicts of interest.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and in the HTML and PDF versions of the article at www.jhqonline.com.

DOI: 10.1097/JHQ.0000000000000305

The authors noted lower rates of intubation in proned patients, but this association did not reach statistical significance. Recently, a prospective cohort study of 56 nonintubated patients with COVID-19 demonstrated improved oxygenation during episodes of proning, although this was only sustained in the supine position in 50% of patients.[29]

At the time of the spring surge, there was no significant evidence for therapeutics which improved mortality. In the absence of a standard of care treatment, management consisted of supportive care, including invasive and noninvasive oxygen support and treatment with steroids and antivirals.[30] In addition, many patients received off-label or compassionate-use therapies.[31] The medical center had minimal experience with positional therapy for nonintubated adults. Our purpose was to demonstrate the feasibility of a proning protocol given this collective inexperience. The primary goal was to promote patient and provider awareness of proning and increase the total number of patients proned, with effective nursing documentation.

Methods

Overview

Hospitalist investigators working on an inpatient COVID-19 unit at an academic medical center convened this quality improvement (QI) initiative. After the Plan-Do-Study-Act model, we did a comprehensive literature review to bolster the physiological justification for proning. Investigators met on a weekly basis with key stakeholders including nursing administration, hospital informatics, and physician providers. Initial meetings developed the protocol and inclusion and exclusion criteria, whereas subsequent efforts focused on creating educational material for patients and providers. There were three distinct phases to the project: the baseline period after the release of the protocol, a period of nursing and provider education, and the period after the creation of a COVID-19–specific electronic health record (EHR) proning order.

Context

The QI project was conducted from March 22nd through June 5th 2020, at a 650-bed academic urban tertiary referral center with over 25,000 admissions annually. The project evaluated patients with positive COVID-19 nasopharyngeal PCR tests admitted to floor units dedicated exclusively to these patients. A consistent group of nurses and providers staffed these cohorted units, including residents, nurse practitioners, and attending physicians. Approximately, 20 hospitalists and 100 residents (included post-graduate year 1s, 2s, 3s, and 4s) worked on these units. The nursing staff ratios in the unit varied between 1:4 and 1:3 depending on the patient acuity.

Interventions

A protocol for the proning of nonintubated patients was designed after initial evidence of potential efficacy and widely disseminated practice guidelines from leading institutions.[32] Our protocol encouraged all eligible patients to prone themselves for 2–3 hours 3 times a day or as tolerated. We drafted inclusion and exclusion criteria, prepared educational materials, and delineated appropriate documentation practices (see Appendices 1 and 2, Supplemental Digital Content 1, **http://links.lww.com/JHQ/A133**, **http://links.lww.com/JHQ/A134**). The most important inclusion criteria were hypoxemia and ability to independently pronate and supinate, as determined by bedside assessment by nursing or physician providers. Patients were eligible so long as they required 1–6 L of oxygen by nasal cannula. Continuous pulse oximetry monitoring was the standard of care for all patients on the COVID-19 units. Notable exclusion criteria included altered mental status, fall risk, inability to self-prone, signs of respiratory fatigue, and abdominal/chest wounds or prohibitive recent surgery. Obesity was not a contraindication but made self-proning difficult in some cases.

The project included both educational interventions and an enhancement to the EHR that required all patients with COVID-19 be assessed for proning eligibility on admission. An educational intervention was selected based on its relative ease and speed of implementation. Understanding that education is a relatively weak intervention alone,[33] the team developed an automated intervention to reliably promote proning. Drawing on established models for the implementation of evidence-based practices, it was determined that a forced function within the EHR admission process would reach virtually all providers and achieve a high level of impact.[34–37] For the educational intervention, the study personnel created a "nursing tip sheet" that was given to all nurses on the COVID-19 units that detailed the physiological rationale, proning mechanics, inclusion criteria, and helpful information to improve patient comfort and optimize their experience (see Appendix 1, Supplemental Digital Content 2, **http://links.lww.com/JHQ/A133**).

An additional document, "lying on your belly," was created for patient education using simple, lay language with graphics, which illustrated the importance of and process by which patients could self-prone (see Appendix 2, Supplemental Digital Content 3, **http://links.lww.com/JHQ/A134**). Tips to improve patient comfort included placing a pillow under the abdomen, ensuring cellphones and TV remotes were in reach, and allowing arms to hang at the sides of the bed. The patient education document was approved for dissemination by the hospital informatics department and given to eligible patients.

Investigators, consisting of hospitalists and residents, met with all COVID-19 unit physicians to review the protocol, inclusion and exclusion criteria, and the placement of proning orders in the EHR. Reminders and educational materials were placed in the physician work rooms to encourage compliance. Investigators simultaneously met with nurse managers to review inclusion parameters and proning best practices. Nurse managers held teaching sessions during huddles where educational materials were shared, documentation practices explained, and questions answered. The protocol was designed for nurses to document the timing and duration of each proning episode on the EHR. Education for all parties was being conducted by week six of the project.

The EHR enhancement was made on Week 8, immediately changing the admission process for patients with COVID-19. Before this, proning orders were entered in the EHR on an ad hoc basis using a generic order. Notably, for encounters with patients with COVID-19, physicians were encouraged to use clinical pathways integrated into the EHR. These pathways directed providers to specific order sets when admitting patients. The EHR enhancement added a proning order to the admission pathway for all floor patients with COVID-19, functioning as an electronic hard stop. Inclusion and exclusion criteria were appended to the order, thereby requiring all providers to consider proning at each admission. The inclusion of a mandatory order was made by consensus approval of representatives of the affected provider groups.

Measures

The outcome measured was nursing documentation of patients in the prone position as determined by the retrospective chart review. An independent, gold standard process to verify patient proning was not possible, as noncare team members were not allowed on the COVID-19 cohorted unit. This was to decrease the risk of infection and preserve personal protective equipment. The major process measure was provider order for prone positioning within the EHR. There were two balancing measures evaluated: disagreement between EHR order for and nursing documentation of proning and the number of inappropriately placed prone orders for patients who met exclusion criteria. Disagreement between provider order status and nursing documentation of proning was categorized as a balancing measure as it represents the potential for patient harm.

Investigators acquired information from an EHR information pull identifying three data points: all patient encounters from March 22nd to June 5th admitted with COVID-19, the presence of a provider prone order, and nursing documentation of prone position, as identified by notation in an electronically searchable field or keyword search of all nursing documentation. All encounters were retrospectively reviewed to determine if patients were prone appropriate based on the criteria in the protocol, if the patient was initially cared for by a nonintensive care team, and if there was any additional nursing position documentation.

Analysis

The major outcome measures of EHR orders for prone positioning and nursing documentation of prone positioning were primarily evaluated using a run chart. The run chart used weekly intervals from the start of the first full week of data collection until the end of the study. Both variables were charted as a percentage, where the numerator was represented by the number of admissions with chosen outcome measure and the denominator was the total number of prone appropriate admissions for that week.

The outcome measures, as well as the balancing measures of provider–nursing agreement and patients inappropriately proned, were compared at each of the three phases of the project: baseline, education, and EHR enhancement. This comparison was completed using the Fisher exact test.

Ethical Considerations

This project received a formal determination of quality improvement status according to our hospital's institutional policy. As such, this initiative was deemed not human subjects research and was therefore not reviewed by the institutional review board.

Results

Baseline

The project timeframe of March 22, 2020, to June 5, 2020, included a total of 800 admissions with COVID-19 of which 586 (73.3%) were managed by floor teams for the first full 24 hours after admission. Of these patients, 251 (42.8%) were prone appropriate. The proportion of prone-appropriate patients admitted to floor teams varied throughout the study period from 36% to 55% (Figure 1). The most common contraindications for prone positioning were lack of hypoxia (61%), altered mental status (24%), and high fall risk (6%).

Outcome and Process Measures

During the baseline period after the protocol was initially released (March 22 to April 28), 372 patients were admitted to floor teams with 153 (41.1%) being prone-appropriate. Of those patients, 12% had a provider order for proning, and 18% were documented in the prone position. Early on much of the proning occurred on an impromptu basis by provider bedside recommendation without an EHR order, explaining this discrepancy. The weekly percentage of prone positioning orders and documentation of prone positioning are displayed in the run charts in Figures 2 and 3.

After provider and nursing education and before EHR enhancement (April 29 to May 12), there were 106 new admissions to floor teams of which 58 (54.7%) were prone appropriate. Prone orders were placed for 48% of eligible patients, which was significantly higher than the baseline period ($p < .0001$). Nursing documentation of prone positioning also increased significantly to 52% of eligible patients ($p < .0001$) (Table 1).

After the EHR enhancement was implemented on May 13th until the end of the study on June 5th, there were 108 additional admissions to floor teams with 40 (37.0%) eligible for proning. Providers placed prone orders for 83% of all eligible patients, significantly more than both the baseline period ($p < .0001$) and the educational period ($p = .0007$). Nursing documentation of prone positioning was present for 45% of eligible patients, significantly higher from baseline ($p = .0006$) but unchanged from the education period ($p = .54$) (Table 1).

Balancing Measures

The agreement between provider orders for prone positioning and nursing documentation of position was 84% during the baseline period. After nursing and provider education, the level of agreement was 79% ($p = .42$). After the implementation of the EHR enhancement, the level of agreement decreased to

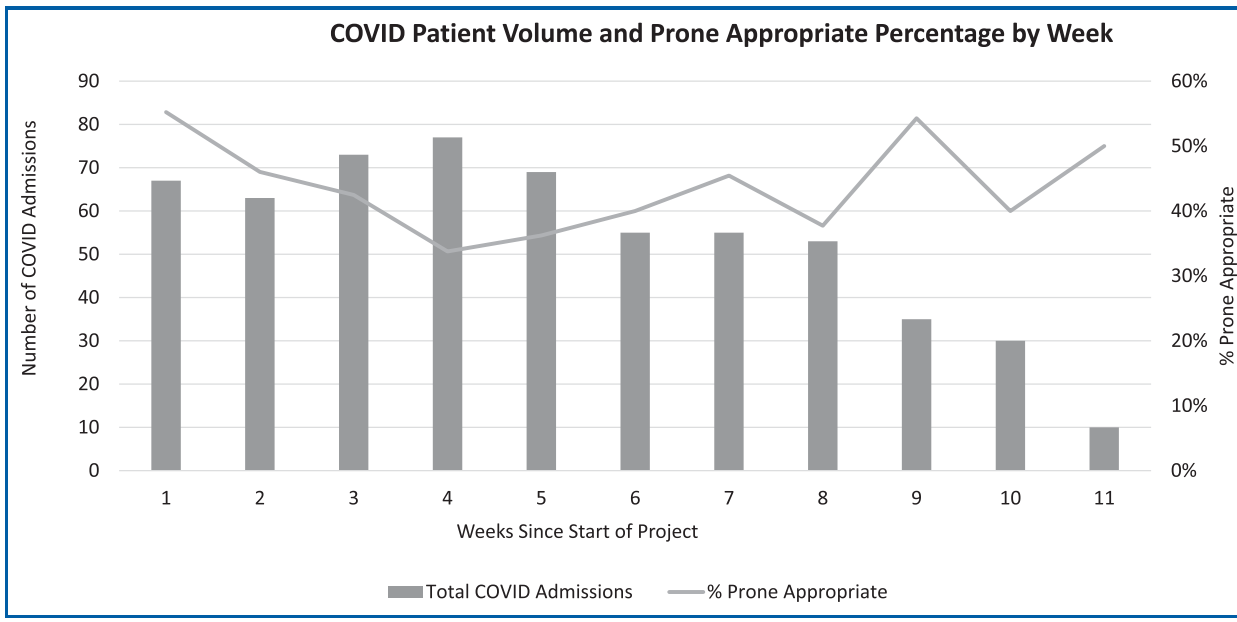

Figure 1. Covid patient volume and prone appropriate percentage by week.

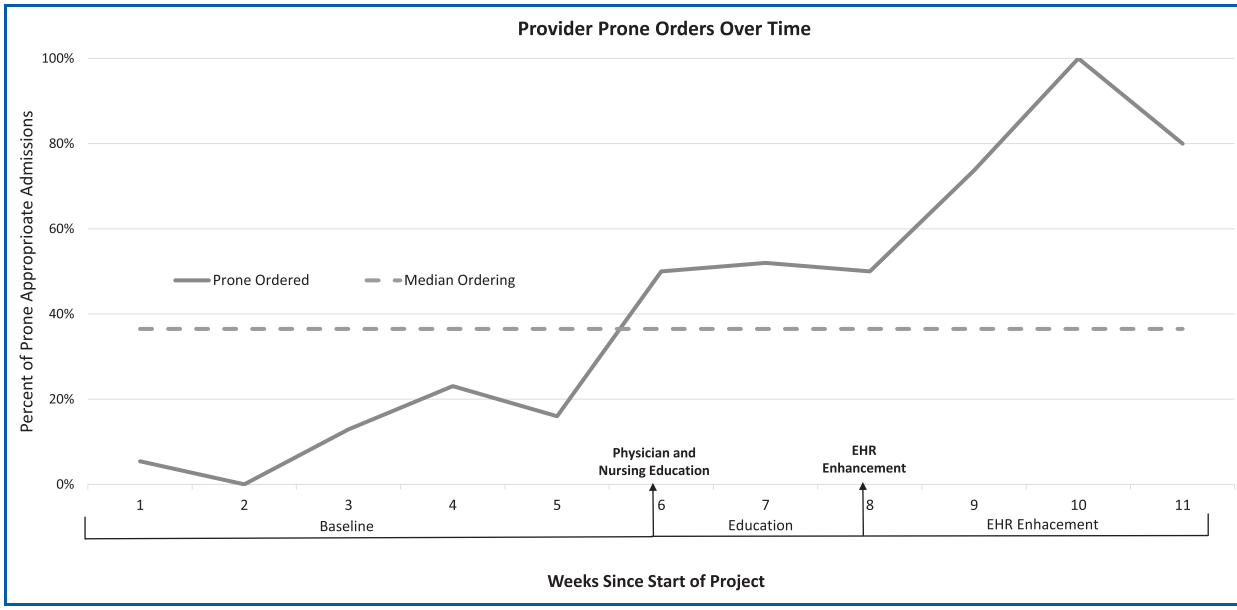

Figure 2. Provider prone orders over time.

63% ($p = .11$). This was significantly lower than the baseline period ($p = .004$) (Table 1).

Throughout the entire study, there were only four patients with prone orders placed when contraindications were present. The contraindications for these encounters were lack of hypoxia, presence of an abdominal wound, and altered mental status (twice).

Limitations

This is a single-center QI study that reports on the development and implementation of a hospital-wide proning protocol. As with any single-center study, this project is limited by a sample patient population presenting to one academic medical center. The nursing infrastructure, cohorted COVID-19 units,

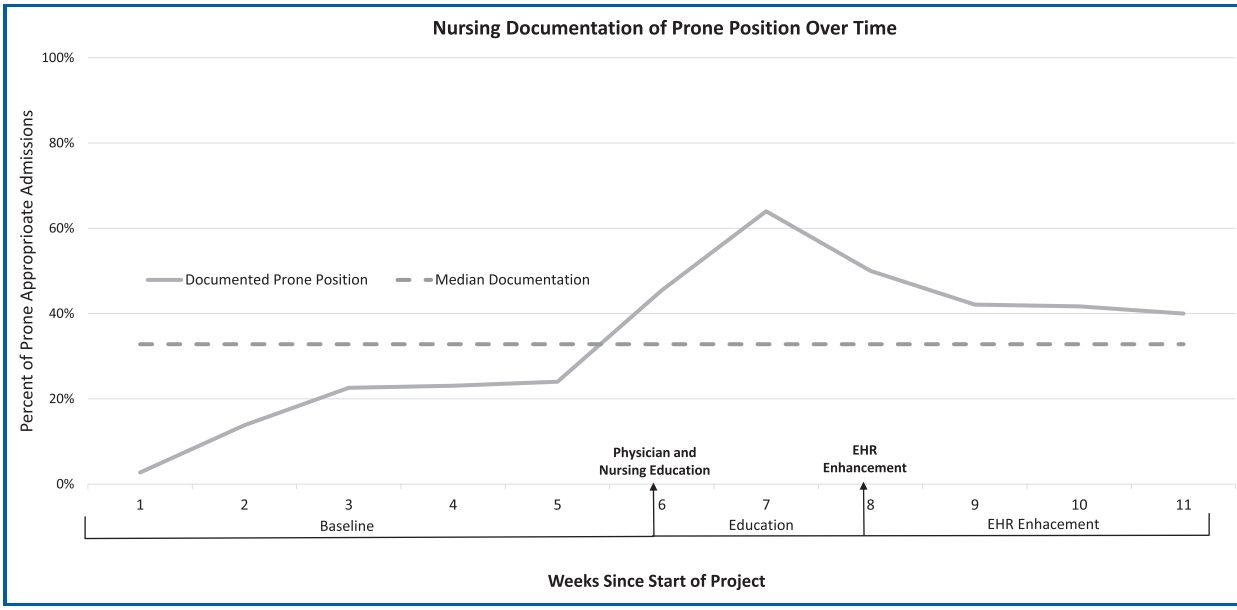

Figure 3. Nursing prone position documentation over time.

Table 1. Outcome Measures After Implementation of Physician/Nursing Education and Electronic Health Record Enhancement

	1. Baseline	2. Physician/nursing education	3. EHR enhancement	1 vs. 2	1 vs. 3	2 vs. 3
Provider order	12%	48%	83%	*p < .0001*	*p < .0001*	*p = .0007*
Nursing documentation	18%	52%	45%	*p < .0001*	*p = .0006*	p = .54
Order-documentation agreement	84%	79%	63%	p = .42	p = .004	p = .11

Italic values are statistically significant.

patient population, and EHR capabilities are not representative of all hospitals. Thus, it is uncertain if this study is generalizable to other settings.

In addition, the study only evaluated whether or a not a patient proned once. It did not assess the number of times each eligible patient proned or the duration of each proning session. There was significant variation in the time spent prone which is not captured by this project. Furthermore, this study does not evaluate the clinical efficacy of proning non-intubated patients. There are no results from randomized control trials investigating proning non-intubated patients, although two are ongoing. As such, the clinical benefit of proning, beyond improvement in hypoxia, remains theoretical for now.

Discussion

This single-center QI study demonstrates the feasibility and the shortcomings of a hospital-wide proning initiative developed amidst the COVID-19 pandemic. Proning hypoxic patients, previously a maneuver reserved only for intubated patients with ARDS, is increasingly being used on medicine floors in hopes of preventing decompensation and intubation. It is an affordable and simple intervention which has been shown to improve oxygenation by several physiological mechanisms. We created a standardized proning protocol with simple inclusion and exclusion criteria that entailed the self-proning of hypoxemic patients 3 times daily for 2–3 hours or as tolerated. The protocol was triggered by an order placed in the EHR, and prone position and time were documented within existing EHR flowsheets. Within 10 days, educational materials for both patients and providers were created, approved, and shared with physicians and nurses.

To evaluate the efficacy of the proning protocol, we completed a chart review of all patients admitted to the hospital with COVID-19. During the study period, 586 floor patients were admitted to the hospital with COVID-19, of which 251 (42.8%) met inclusion criteria. Our data show both strengths and weaknesses in the protocol. During the baseline period immediately after the release of the protocol, only 12% of eligible patients were identified as prone appropriate with only 18% of appropriate patients documented as proned. After an educational initiative targeted at patients, nurses, and physicians, 48% of eligible patients were identified, and 52% of all eligible patients were proned. This was achieved by the creation and dissemination of educational materials tailored to both patients and nurses, daily teaching sessions during nursing huddles, and videoconference lectures for physicians. This required close collaboration between physician and nursing leadership, in part synergized by working together on a closed, cohorted unit.

After the creation of an EHR enhancement, which functioned as an electronic hard stop requiring all providers to consider proning during the admission process, identification of eligible patients further increased to 83%. The EHR enhancement did not achieve 100% efficacy because of the onboarding of new providers in the final weeks of the project. These providers did not all have an opportunity to be briefed on our proning measures and occasionally used generic order sets when admitting patients. There was no significant change in the total percentage of eligible patients proned (45%). This slight decrease from the prior period is perhaps explained by less ongoing nursing education and cumulative fatigue from the pandemic.

At the end of the study, a significant gap remained between patients with proning orders placed (83%) and patients documented proned (45%), a breakdown in the translation of care from physician to the bedside. We believe this gap existed primarily because of patient preference. Notably, the decision

to self-prone was entirely voluntary, and many patients declined for reasons of comfort. Dyspnea, body habitus, restrictive hospital beds, and insight all affected an individual patient's willingness to prone. It is also likely that some units' nursing staff received more intensive education about the proning initiative than others, leading to more or less enthusiasm about its implementation. The differences in nursing attitudes about the benefits proning are documented in a separate article which shows significant variation between units.[38] This underlines a need for more uniform and ongoing education to promote awareness among both nurses and physicians.

Early evidence on the efficacy of proning in awake, nonintubated patients is encouraging, although far from definitive. Currently, there are no studies that demonstrate proning improves mortality outcomes in nonintubated patients, but its salutary effects on oxygenation are well established. Further work needs to be performed to fully elucidate the potential effects of self-proning on clinical outcomes such as ICU transfer, intubation, and mortality. Given both the exigencies of the COVID-19 pandemic and the relatively limited therapeutic options, proning nonintubated patients seems to be a safe, feasible, and affordable intervention. Our protocol was developed and implemented on an entirely voluntary basis, without any cost to the hospital system. We believe that as the pandemic continues to evolve, proning protocols for nonintubated patients will be increasingly adopted.

Conclusions

A proning protocol to identify hypoxic patients with COVID-19 and encourage them to self-prone is safe, feasible, and affordable and can be accomplished in a relatively short period of time. This proning protocol increased both provider awareness of patients eligible for proning and the total number of patients proned, although there was a significant gap between patients eligible for proning and those documented as proned. This was achieved by educational interventions and a proning EHR hard stop. Although proning nonintubated patients have been shown to improve oxygenation, its effects on other clinical outcomes such as intubation and mortality remain uncertain.

Implications

The creation of a hospital-wide proning protocol to address the exigencies of the COVID-19 pandemic is possible and may be accomplished in a relatively short period of time. With educational interventions for patients, nurses, and physicians and EHR innovations, hospitals can readily implement proning protocols.

Authors' Biography

Felicia R. D'Souza, MD, is a clinical associate/hospitalist at the University of Chicago in Chicago, IL. Before that, she worked as a hospitalist at Washington University in Saint Louis, MO, for 2 years. She currently works as a nonteaching hospitalist and also does couple of weeks of teaching service at the University of Chicago and a hospital affiliated with them.

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